

# METHODS AND SYSTEMS OF NETWORK MANAGEMENT

## RELATED APPLICATION

The present application claims priority to and the benefits of the prior-filed co-pending and commonly owned provisional application entitled "ADSL Network Management System", filed in the United States Patent and Trademark Office on August 27, 1999, assigned Application No. 60/151,120 and incorporated herein by reference.

## FIELD OF THE INVENTION

The inventions described herein relate to the field of telecommunications, and particularly, relate to the provisioning and management of digital subscriber line (DSL) services such as asymmetric digital subscriber line (ADSL) services.

## BACKGROUND

Fast access to the Internet. Many products and services advertise fast access to the Internet, and many deliver fast access, but only after the customer has been provisioned and otherwise set-up to receive and connect to the services for appropriate interface with the Internet. The actual "provisioning" and related































the region-wide screen may include the following actions: File; Window; NetworkCreation; Inv/CapacityMgmt; Programming; Diagnostic; and Service.

Referring again to fault management, as noted, Fig. 3A illustrates the region-wide screen 178 of a nine-state area 180 of the United States where the equipment of the NMS may be located. Within the representation of each state, a large dot (or circle) is positioned. For example, a large dot 182 is positioned within the representation of the State of Georgia 184. The color of the dot 182 indicates the status of the equipment within that state. The screen 178 also includes a code or legend bar 186 with representations of the correlation between colors of the dots and status of the equipment. For example, a red dot indicates critical conditions; an orange dot includes a major alert; a yellow dot indicates a minor alert; and a green dot indicates a normal status.

An exemplary NMS may include further detail than just the status of the equipment in any particular state as indicated by the dots on the nine-state area 180 illustration. A user may click on or otherwise select any one of the dots and “drill-down” through links associated with the dot to further level of detail included in windows that are presented to the user. The windows provide at least two functions: (1) they allow a user to research and identify the equipment in each state, LATA, building location, and ATM switch; and (2) the windows allow the user to search for, and identify, the source of an alert.

Reference is made to Figs. 3B – 3\_\_ for additional details provided in an exemplary fault management segment of an NMS. If a user selects the dot 182 in the representation of the State of Georgia 184 in the nine-state illustration 180, then the









window 246 such as illustrated in Fig. 3M. The On-Line Window Adviser supplies details on the selected alert.

The exemplary NMS includes error logs, which are files that contain details of error or problems that have come up within the NMS. These logs can be referenced to discover details of any system-generated error condition. There are six exemplary error logs:

- Rma.log: Request for Manual Assistance; contains service order errors;
- Act.log: Documents the activities performed from the graphic user interface by a user;
- Sys.log: Documents NMS internal errors;
- Cust.log: Documents facility failures and provides a list of the affected end-users;
- ServiceOrder.log: Maintains a copy of the service orders; and
- Interface.log: Maintains a record of interface activity.

The logs may reside in a log directory in the exemplary NMS.

Another feature of the exemplary NMS is that it may be configured to provide notifications such as electronic mail messages (e-mails) when an alert comes into being. For example, when DSLAM capacity approaches established thresholds, then an e-mail may be sent to one or more users.

### Diagnostic Functions of an Exemplary NMS

An exemplary NMS also includes diagnostic functions, which may be accessed by a user through use of a graphical user interface (GUI) of the NMS such as through the region-wide screen 178 as illustrated in Fig. 3A. The screen 178 includes an option for "Diagnostic" that may be selected by the user. The diagnostic functions allow the user to research port and PVC connections, and to determine the customers (or other end users) who may be affected by upstream actions.

If the user decides to proceed with diagnostic functions and selects "Diagnostic" from the region-wide screen 178, then a drop-down menu appears including the following features: Translate Port; Customer PVC; Find Circuit Name; Network PVC; and Find Affected End Users.

Fig. 4A illustrates a Translate Port Name window that allows a user to translate between and among the names of ports of elements in the equipment.

The Customer PVC function allows the user to have a network view of how a customer is connected to the overall network. For example, the Customer PVC function allows for the display of a window that includes the customer's VPI/VCI assignment, the COSMOS name, etc. To implement this function, the user may use the Diagnostic-Customer PVC window 242 as illustrated in Fig. 4B. The window 242 includes a customer ID field for the customer's telephone number or other identifier. If this field is populated, then the other field in the window 242, the PVC ID, populates. The user then may proceed to obtain additional information by

selecting the “OK” option, which brings up either the PVC ID window 254 as illustrated in Fig. 4C or the PVC ID window 258 as illustrated in Fig. 4D.

The PVC ID window 254 as illustrated in Fig. 4C provides an end-to-end view of the customer's Direct VCC network connections. This window 254 includes a button 256 for Retrieve ADSL Port Detail. By selecting this button 256, the software version, port status, and the modem initialization state may be retrieved. If any problems exist, then the pertinent information on the window may be highlighted.

The Find Circuit Name function allows the user to display any duplicate VPI/VCI assignments. To implement this function, the user may use the Find Circuit Name window 262 as illustrated in Fig.4E. The window 262 includes a field for CLLI, which if populated, then the port field in the window 262 also populates. If the port then is selected, and any duplicate VPI/VCI exist, then they will show up on the status bar fields included in the window 262.

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viewed and accessed through the Capacity management-Thresholds window 276 such as illustrated in Fig. 5D. The thresholds are global default values for all DSLAMs, preferably. Threshold alarms are generated under the following conditions:

- Actual percentage use is greater than threshold available ADSL = alert
- Actual number of available ports is less than threshold for available ADSL port = alert.

To display the window 276, the user selects Inv/CapcityMgmt from the region-wide screen 178, then selects Edit Capacity Threshold, and then Default DSLAM/Mini-Ram. The Capacity Management – Thresholds window 276 may be used to set the default port availability threshold and saturation thresholds for a CO DSLAM, remote DSLAM, or Mini-Ram. The values illustrated in window 276 are exemplary default values. In the Available Port Threshold: field of the window 276, the value is an absolute number. In the Saturation Threshold field of the window 276, the value is a percentage of 576, which is the maximum capacity of a DSLAM. This value could reasonably be increased to 80%.

The Per DSLAM option brings up the Capacity Management Thresholds window 278 such as illustrated in Fig. 5E. This window 278 may be used to set the default port availability threshold and saturation thresholds for a specific CO DSLAM/remote DSLAM. Percentage utilization = (number of cross-connected ports)

divided by the total DSLAM ports (576). In the window 278, in the CLLI field, if the CLLI is entered and the retrieve command button is clicked, then the other fields populate according to the DSLAM selected. In the Saturation threshold field, the new value entered overrides the globally established default value. An alarm is inhibited (once a DSLAM is full), when the Saturation Threshold Alarm Inhibited field of the window 278 is changed from its value of 0 to 1. When an alarm is enabled, the system produces alarms any time the threshold is reached. In the Available Port Threshold field of the window 278, entry of the new value overrides the globally-established default value. To inhibit an alarm (once a DSLAM is full), proceed to the Ports Available Alarm Inhibited field of window 278 and change its value from 0 to 1. When an alarm is enabled, the system produces an alarm any time the threshold is reached.

The Per Mini-Ram option brings up the Capacity Management – Mini-Ram Thresholds window 280 as illustrated in Fig. 5F. This window can be used to set the default port availability threshold and saturation thresholds for a specific Mini-Ram.

Percentage utilization = (number of cross-connected ports) divided by the total Mini-Ram ports (8 or 16). Three fields may be entered on this window 280. In the window 280, in the CLLI field, if the CLLI is entered and the retrieve command button is clicked, then the other fields populate according to the Mini-Ram selected. In the Saturation threshold field, the new value entered overrides the globally established default value. An alarm is inhibited (once a DSLAM is full), when the Saturation Threshold Alarm Inhibited field of the window 280 is changed from its value of 0 to



such as card number; type; SW version; vendor; serial number; and status. To display the desired information, the CLLI is entered and the fields populate.

### Service Management

The exemplary NMS may include service management functions to manage bulk PVC, deny, restore, or edit service, edit a customer's record, delete a service order, and modify the customer's profile. The service management functions include seven features that may be accessed via a drop-down menu from the option "Service" on the region-wide screen 178 as follows: Bulk PVC; Deny Service; Response Service; Edit Service; Edit Customer Record, Delete Service Order, ATUR-NSP; and ATUR-Service Gateway.

For the Bulk PVC feature, three menu selections appear on a further drop-down menu as follows: Add Bulk PVC; Edit Bulk PVC; and Delete Bulk PVC. In particular, if the user selects the Add Bulk PVC, then window 286 as illustrated in Fig. 6A appears. The bulk PVC is used to move all logical circuits from one physical link to another. The new ATM port changes the physical link Z end point. All PVCs are moved on the due date. Failure to move any PVC generates an alert. The bulk PVC order can be edited using the Edit Bulk PVC menu option which generates the window 288 as illustrated in Fig. 6B. To edit, a service order number is selected from the pick list in the Order Number field, and then the Edit Bulk PVC window 290 as illustrated in Fig. 6C appears. In window 290, in the Old NSP CID field, the old NSP circuit ID is entered. IN the CLLI field, the CLLI is entered. The rack and shelf fields contain default values and are skipped. In the Slot field, the slot number is



the customer's telephone number in the Customer ID field, the other three fields populate (name, address, and zip code).

For Deleting a Service Order feature, if the Delete Service Order option is selected, then window 304 such as illustrated in Fig. 6J displays. This feature is recommended to be used only in emergency situations. Once the service order number is entered in the SO Number field, the service order is deleted.

The Modify a Customer's Profile feature is used to reduce a customer's ADSL connections speed to a maintenance mode. For Modifying a Customer's Profile feature, if the Modify Customer's Profile option is selected, then window 306 such as illustrated in Fig. 6K displays. The Customer ID field is filled with the customer's telephone number, and then the pick list field in the PVC ID field populates with a PVC selection. The user may click on the triangle in the window 306, and select a PVC from the list that displays. The maintenance profile (Maint) then may be selected from the list.

### Deleting Network Elements

The above description included details about exemplary network creation in the NMS database. The exemplary NMS allows for the deletion of network elements from the network. Interdependent elements may be deleted in the NMS database in the following sequence:

- Physical link: DS1, DS3, OC3, or OC12

- Mini-Ram
- NSP; DSLAM; ATM switch
- Remote site
- Location (type Building Location, NSP)

Individual components of a network element generally may not be deleted. The deletion of a DSLAM causes the automatic deletion of all of its associated racks, shelves, cards, and physical ports.

The drop-down menus for deleting network elements are accessed through the region-wide screen 178, and particularly, through use of the NetworkCreation option on the region-wide screen 178.

To delete a physical link, the NetworkCreation option leads to a drop-down menu that includes Physical Link, which should be selected, and then the Delete Physical Link option should be selected. The Delete Physical Link window 308 as illustrated in Fig. 7A appears. In the Circuit ID field, the circuit ID may be entered. The data then is committed to the database.

To delete an NSP, certain prerequisites must have been satisfied: it must be verified that all PVCs have been disconnected from the NSP to the DSLAM; and it must be verified that each physical link connecting the NSP to the ATM network is deleted from the NMS. Once these prerequisites have been satisfied, then to delete an NSP, the NetworkCreation option leads to a drop-down menu that includes NSP, which should be selected, and then the Delete NSP should be selected. The Delete

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To delete an ATM switch, the NetworkCreation option leads to a drop-down menu that includes ATM, which should be selected, then the ATM Switch, and then the Delete ATM Switch. The Delete ATM Switch window 314 appears as illustrated in Fig. 7D. In the CLI field, the CLI code is entered, and the delete is committed to the database.

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In the CLI field, the CLI code is entered, and the delete is committed to the database.

To delete a building location, the NetworkCreation option leads to a drop-down menu that includes Building Location, which should be selected, and then the Delete Building Location. The Delete Building Location window 318 appears as illustrated in Fig. 7F. In the CLI field, the CLI code is entered, and the delete is committed to the database. However, the location may not be deleted if the location has any DSLAM or ATM switch associated with the location; or if the location has any physical ports associated with it that are associated with physical links. Deleting a location also deletes the ATM physical port on the ATM network that is associated with the location. These ports have no associated physical links.

From the foregoing description of the exemplary embodiments of the present inventions and operations thereof, other embodiments will suggest themselves to those skilled in the art. Therefore, the scope of the present invention is to be limited only by the claims below and equivalents thereof.